but from the appearance of dried fragments they seem to be of a deep red.

According to the herbarium of my friend Sir William Hooker, it appears that this species was observed in Bootan by the late Mr. Griffith. The specimens referred to are branches without flowers or fruit.

Dedicated to the memory of my much-revered friend and botanist, the late Dr. Kendrick of Warrington.

V.—*On Relative Position; including a new Arrangement of Phanerogamous Plants.* By B. Clarke, F.L.S. &c.

[With a Plate.]

Part IV.

On Dorsal Placentation.

The instances in which this variation from usual placentation takes place deserve particular attention as having a direct bearing on affinities, the structure of the ovary, and the position of the carpel when single; but this involves a question relating to the structure of the ovary of *Nelumbium* which requires to be first more particularly noticed. The discovery that in this genus the raphe of the anatropal ovule is turned away from the adherent funiculus, has been the occasion of an extended inquiry into the structure of its remarkable ovary, and repeated examinations in different stages of its development have led to the conclusion that the carpels always stand with the ventral suture outwards, that is, turned towards the stamens.

The cause of this singular departure from ordinary structure is however difficult to explain, but seems owing to one of the following circumstances:—1. Either the real ovary is rudimentary, consisting only of the disk in which the carpels are immersed, and the carpels themselves belong each to a separate flower (each rudimentary carpel producing from its base one female consisting of a single carpel); or, 2. the ovary is apocarpous as generally understood and the carpels are turned outwards.

In support of the first hypothesis, it may be observed that the disk in which the carpels of *Nelumbium* are immersed differs from such structures in other families in being continuous with the stem, in consisting internally of irregular cavities separated by thin walls, and in containing an abundance of spiral vessels. But supposing that this were its structure, it might be expected that as each carpel belonged to a separate flower there would be some

variations in its position; but this is not the case, as the carpels have regularly the ventral suture turned outwards; and this suggests the idea that carpels (like leaves revolute in vernation) may be formed by the margins of the carpellary leaves being turned, and meeting outwards instead of inwards. May not stamens also, being turned outwards or inwards, be analogous in some cases to the vernation of leaves? In *Tormentilla officinalis* I have observed carpels among the stamens (stamens metamorphosed?) having the ventral suture apparently outwards, the tendency of the anthers being also to open outwards. But as in *Ceratophyllum* and *Piperomia* the carpels are all posterior, the uniformity of the position of the carpel in *Nelumbium* forms only a partial objection, and the former is probably the true solution of the question.

A further argument in support of the hypothesis that in *Nelumbium* the ovary has the ventral suture turned outwards, is derived from the fact that in the Nymphal Alliance the placentation is, as Mr. Brown has remarked, dorsal, variations even when they do take place being only partial; for supposing the carpel to be so placed, *Nelumbium* agrees in this character also in the adherent funiculus being always at the inner angle of the carpel (Pl. III. figs. 1, 2, 3 & 4). The occurrence of dorsal placentation in other families allied more or less nearly also makes it probable that this is the true structure of *Nelumbium*, and on this account an especial notice of them may be the more interesting, passing over those in which the ovules are numerous, viz. Orobanchaceæ (in some genera only), Nymphæaceæ, Butomaceæ, and possibly Hydrocharidcæ.

1. *Hydropeltis purpurea.* Ovules two, pendulous, anatropal, having the raphe turned away from the placenta, and attached one above the other to the dorsum of the carpel*. (Pl. III. fig. 6.)

2. *Cabomba aquatica.* Ovules three, pendulous, anatropal, having the raphe turned away from the placenta (occasionally lateral?), one attached to the ventral suture near the apex of the carpel, and the two others to its sides midway between the dorsal and ventral sutures. These two ovules are attached to two cord-like ribs which originate in the base of the cell, and are continued upwards to the attachment of the third ovule. (Pl. III. fig. 7.)

3. *Ceratophyllum demersum.* Ovule single, pendulous from the apex of the cell in consequence of the funiculus to the apex of which it is attached being firmly adherent to the dorsum of the carpel. This funiculus originates in the base of the carpel

* That the ovule is anatropal is further shown by the embryo being next the hilum.

as in *Nelumbium*, and is always more or less distinctly visible in the early stages of the flower* (Pl. III. fig. 5). From this character the nearest affinity of *Ceratophyllum* may be, as first suggested by Dr. Asa Gray, with *Nelumbium* rather than with Piperaceæ, which, from the position of its carpel, I formerly supposed might be its true station. Its habit however is more that of *Cabomba*, with which it agrees in the stamens being turned outwards instead of inwards, as in *Hydropeltis*; it may also be regarded as having some analogy with Hydrocharideæ in its orthotropal ovule, exalbuminous seed and unisexual flowers, and possibly with *Cryptocoryne* in its many-leaved plumule, and it further agrees with Hydropeltideæ in its cellular leaves.

4. *Chloranthus*. The ovary of this genus agrees with that of *Ceratophyllum* in always having the appearance of a funiculus arising from its base which is constantly attached to the posterior side. That the posterior is the dorsal side of the ovary is the most probable, as the stigmatic tissue always descends on its anterior side, having first obliquely crossed its thickened summit; and that this is the true structure of *Chloranthus* is placed almost beyond doubt by the carpel in *Piperomia* and in *Houttuynia* when single being always posterior. (See the figure of *Chloranthus* accompanying Part III.)

5. *Arum maculatum*. Ovules five or six ascending, always attached to the posterior side of the carpel (its lower half); stigma having its anterior surface only stigmatic as in Piperaceæ, the posterior being not unfrequently almost vertical and rounded (Pl. III. fig. 8). Although it may not be considered as fully demonstrated that in *Arum* the carpel is posterior, yet it is obvious that it must be either always anterior or always posterior, and as it is variable and more frequently posterior in Typhaceæ, it is very improbable that it is always anterior in *Arum*, and a comparison also with *Cryptocoryne* may perhaps be adduced as a further argument. In genera nearly allied to *Arum* the placentation is however not dorsal, but the ovules being partly sutural in *Cabomba* and entirely dorsal in *Hydropeltis*, shows that this difference of placentation may take place in genera very nearly allied, if not in the same genus, as in *Mesembryanthemum*.

Cryptocoryne. From Mr. Griffith's figures of *C. ciliata*

* The following circumstance seems also to show the placentation of *Ceratophyllum* to be the same as that of *Nelumbium*. Having three immature fruits of *Ceratophyllum demersum*, I allowed them to remain growing on the plant to produce seeds. But some time afterwards having observed an altered appearance in one of them, I found on examination that the ovary had entirely decayed away, leaving the ovule suspended from the apex of a filiform perfectly entire funiculus which was posterior, and both funiculus and ovule remained attached to the torus quite free from decay for two or three days afterwards.

(Pl. III. fig. 10) it may be expected that this genus is another instance among Araceæ in which the placentation is dorsal, as the fissure of the stigma is in two instances represented as taking place toward the axis (Trans. Linn. Soc. vol. xx. tab. 10). Fissures occurring in the stigmas of single carpels are generally, if not without exception, dorsal, and in *Sparganium ramosum* such fissured stigmas are not unfrequent, the fissure being always dorsal (Pl. III. fig. 9), which is so far a reason for regarding the 5–7-celled ovary of *Cryptocoryne* as produced by the carpels of as many separate flowers. As thus understood all the carpels are posterior having their placentation dorsal, and become adherent, so as to form in appearance one polycarpous ovary; and although this may appear problematical, it would be difficult to account for the structure of *Cryptocoryne* on the ordinary rules of carpology, as Mr. Griffith alludes to other species in which the carpels are more numerous, and adds that he should not be surprised if species be found to exist with ovaria disposed in two or more series, which then would nearly approach *Arum*.

The ovaries of different flowers becoming confluent so as to form a syncarpous mass is not without parallel, as in the monstrous ovaries of *Matthiola incana* it is a very common irregularity that two ovaries, and also three standing in a row, form only one cavity; the confluence taking place at the dorsal suture, or so near it as to be in each case intermediate between the two placentæ, from which it seems possible that this may take place as a regular structure. And in *Opercularia* also adhesions take place between the capsules constituting the small whorls of fruits which remain permanent after complete dehiscence has taken place.

While however dorsal placentation forms an important deviation in the structure of ovaries, its value as a character in separating near allies is but weak, *Monodora* among Anonaceæ being a remarkable example of ovules deriving their attachment from the whole of the inner surface of an ovary consisting of a single carpel, and that in an Alliance which has otherwise ordinary modes of placentation. But, on the contrary, those families in which it occurs may on that account prove to have a direct affinity to each other; and it most probably is, in common with the posterior position of the carpel, and the raphe averse in pendulous anatropal ovules, an Endogenous character, and shows an approach (where it occurs) on the part of Exogens to Endogens.

EXPLANATION OF PLATE III.

Fig. 1. The external appearance of a carpel of *Nelumbium speciosum*, showing the ventral tuberosity which is always turned towards the stamens.

Fig. 2. The same as seen laterally.

Fig. 3. A longitudinal section of it: *a*, the ventral tuberosity. The funi-

culus is seen adherent to the opposite side, and the axis of the style is seen inclining to the ventral tuberosity.

Fig. 4. The same more magnified, showing the cellular somewhat circuitous canal which extends from *a*, the ventral tuberosity, to the cavity of the ovary; the external and internal openings being closed only by a thin layer of cellular tissue: the axis of the short style, together with its termination in the cavity of the carpel external to the funiculus, and also the fibres of the funiculus, are here distinctly seen.

Fig. 5. An ovary of *Ceratophyllum demersum* in longitudinal section.

Fig. 6. A carpel of *Hydropeltis purpurea* in longitudinal section: *a*, the ventral side which is turned towards the axis of the polycarpous ovary.

Fig. 7. A carpel of *Cabomba aquatica*, the dorsum having been removed. Two ovules are seen attached to the lateral fibres, which are continued upwards and meeting at the ventral suture become continuous; at this part the third ovule is seen attached.

Fig. 8. An ovary of *Arum maculatum* in longitudinal section: *a*, the anterior side.

Fig. 9. An ovary of *Sparganium ramosum* in which the dorsal portion of the stigma had become fissured; when dicarpous, which frequently happens, the stigmatic surfaces of the two carpels are turned towards each other.

Fig. 10. *Cryptocoryne ciliata*: *a*, the fissured stigma. (Griffith.)

VI.—*On the Phosphorescence of some Marine Invertebrata.*

By M. A. De Quatrefages*.

I. *Historical review of the Subject.*

1. *Causes of phosphorescence.*—It is well known that the waters of the sea, in some latitudes and under certain circumstances, are phosphorescent, producing a light more or less brilliant. This remarkable phænomenon has always attracted the attention of travellers, and various have been the explanations they have offered. Without going here into useless detail, we will first mention those hypotheses which are now completely set aside, before dwelling on better-founded opinions.

Ancient navigators seem to have indicated a resemblance between the light produced on the surface of the water and that which is due to atmospheric phænomena, by designating the former "meteors of the sea." Something of this idea is evident even in the writings of learned men, who endeavoured to explain this phosphorescence solely by physical or chemical causes. Thus Nollet could see in it only a simple modification of electrical phænomena. Bajon, in his memoirs on the History of Cayenne, regards this light as due to the electricity of the waves, deve-

* From the Annales des Sciences Naturelles, vol. liv. 3rd series, as inserted in Silliman's American Journal of Science for March, 1853.